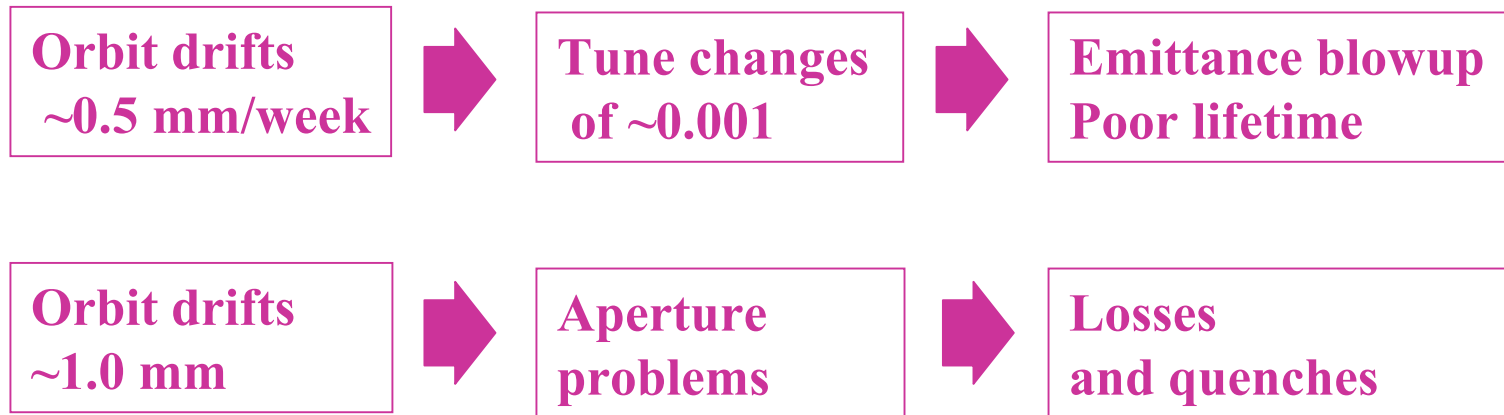


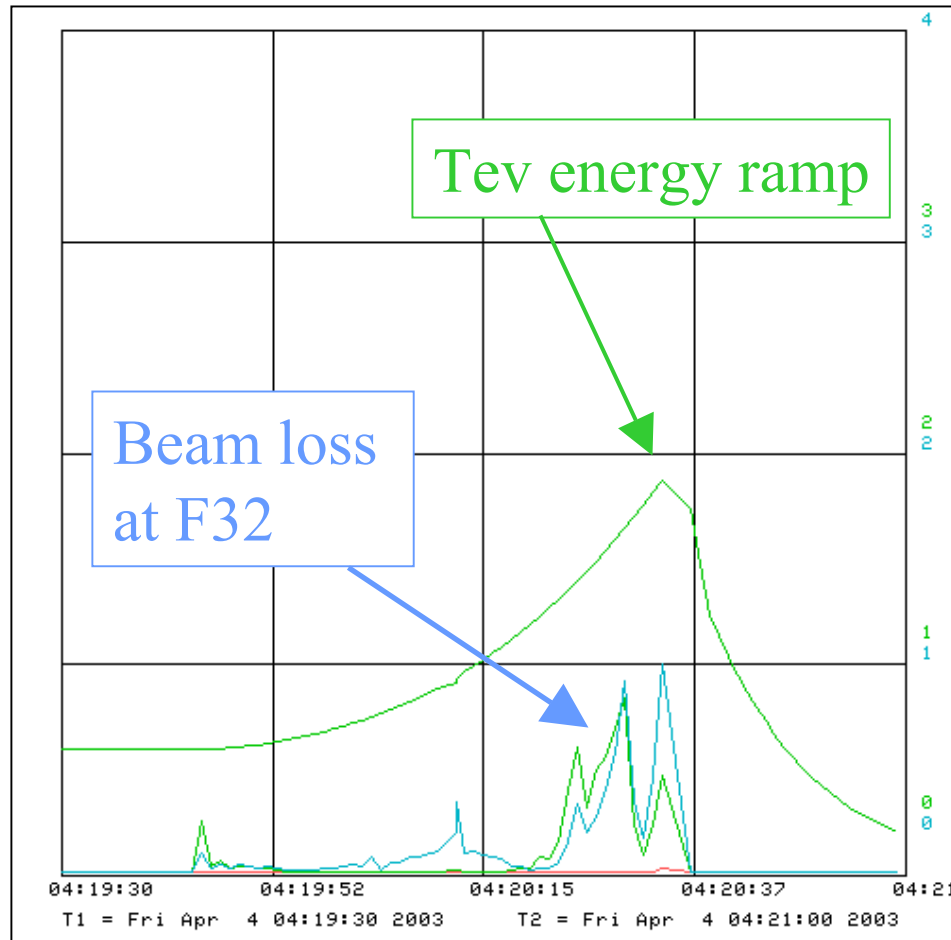
Tevatron Orbit Smoothing

Motivation for smoothing



Important to have stable orbits for machine studies.
Example: Aperture on the new helix at 150 GeV.

Tevatron Orbit Smoothing



Recent example

Problem:

3 quenches @ 400 GeV
from losses at F32

Solution:

A +2 mm horizontal
bump @ HPF32

Goal for Orbit Smoothing

Find a set of “**Golden Orbits**” with beam

- in the center of the magnets.
- in the center of aperture at tight spots.
- at the correct location for injection and abort.
- at a good location for experiments.

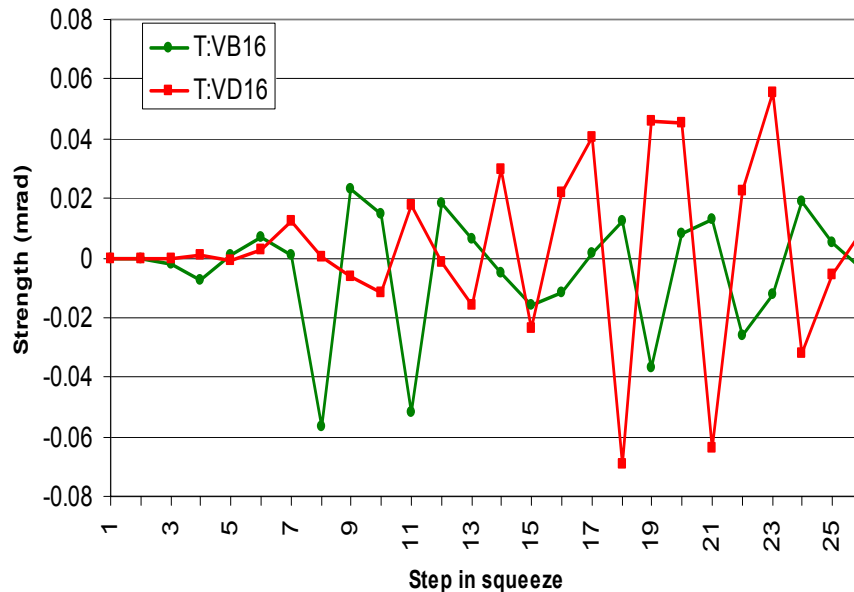
Develop a “**Standard Smoothing Procedure**” that

- keeps the orbits stable.
- is done consistently.
- can be done relatively quickly.

Some History of Orbit Smoothing

August 2002

Corrector strengths in the squeeze.



Corrector strengths fluctuating
by 50 amps during the squeeze.

In August 2002.

Found erratic orbits
and corrector settings.



Overhauled the orbits
corrector setting.



Developed a “standard
smooth procedure”

Some History of Orbit Smoothing

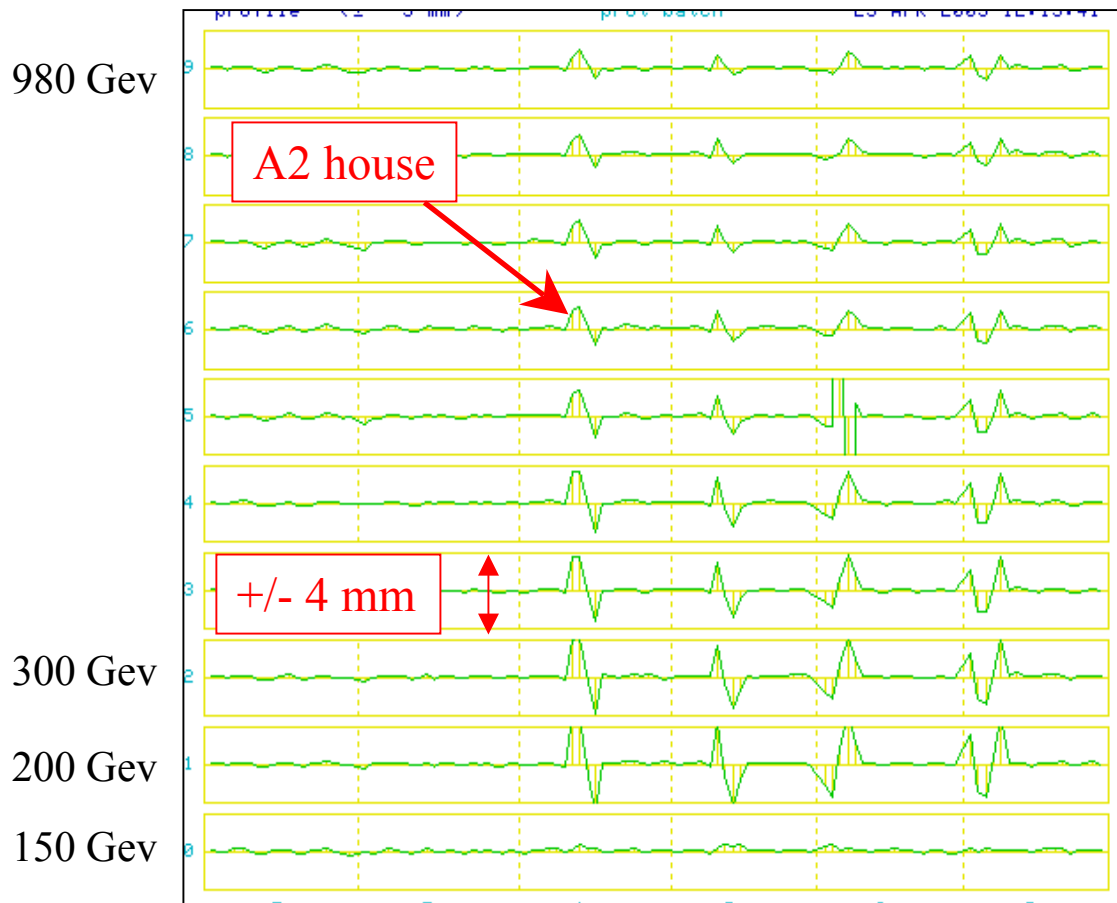
Standard smoothing worked well until Mar 2003.

Then things got “mucked up” due to:

- A “non-standard smooth” (and a software change.)
- ~0.5 mm orbit drifts from an unnoticed C:B0QT3 trim quad error.
- ~0.5 mm orbit changes from unnoticed TEL magnetic corrector trips.
- Some backwards BPMs.
- Possible “stale orbit data” ??

- Orbits were not where we wanted.
- Correctors running near their 50 amp limit.
- Standard smoothing procedure no longer worked.

Troubles with Orbit Smoothing



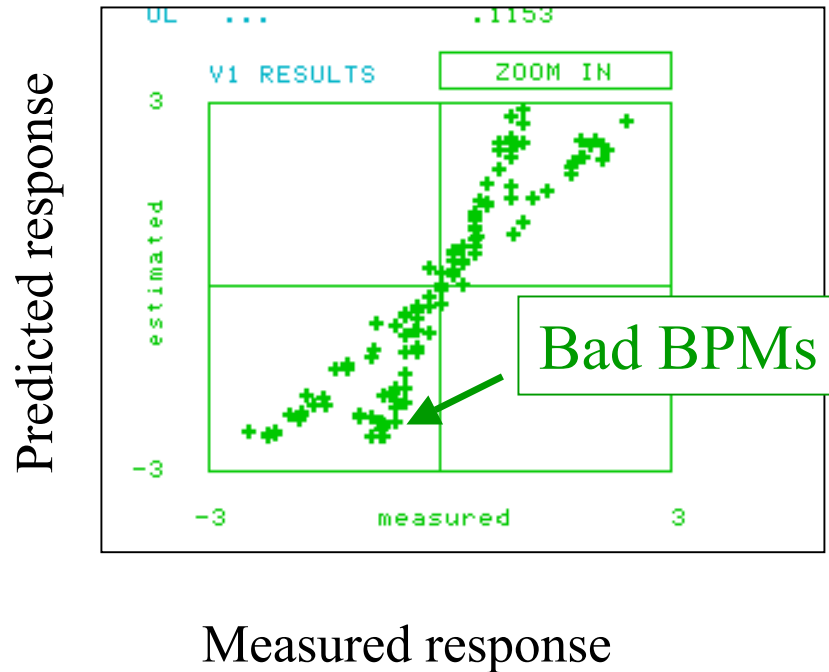
Orbit difference at several ramp energies.

Some BPM houses reported old orbit data

Obvious this time:
Old data \Rightarrow helix.
New data \Rightarrow no helix.

No independent way to verify validity of orbit data.

Improvements



Diagnostic program to test BPM response before orbit smoothing.

We are working on:

BPM electronics

Diagnostic software

Tracking orbits in SDA

Robust smoothing procedure.

Tevatron Orbit Smoothing

Smoothing on 4/22/2003

- Reduced current in correctors.
- Reduced slew rates in correctors.
- Kept (or tried to keep) positions in straight sections the same.
- Put orbits in center of magnets in the arcs.
- Lowered A0 abort block by 3 mm.
- Had to retune the Tev. (Tunes changed by 0.01)
- Should be able to perform a “standard smooth.”

Conclusions

- Smoothing is necessary for Tev operations.
- Re-worked the orbits in August 2002.
- Smoothing went well till March 2003.
- Number of problems resulted in poor orbits.
- Re-worked orbits again in April 2003.
- Working on improving diagnostics.